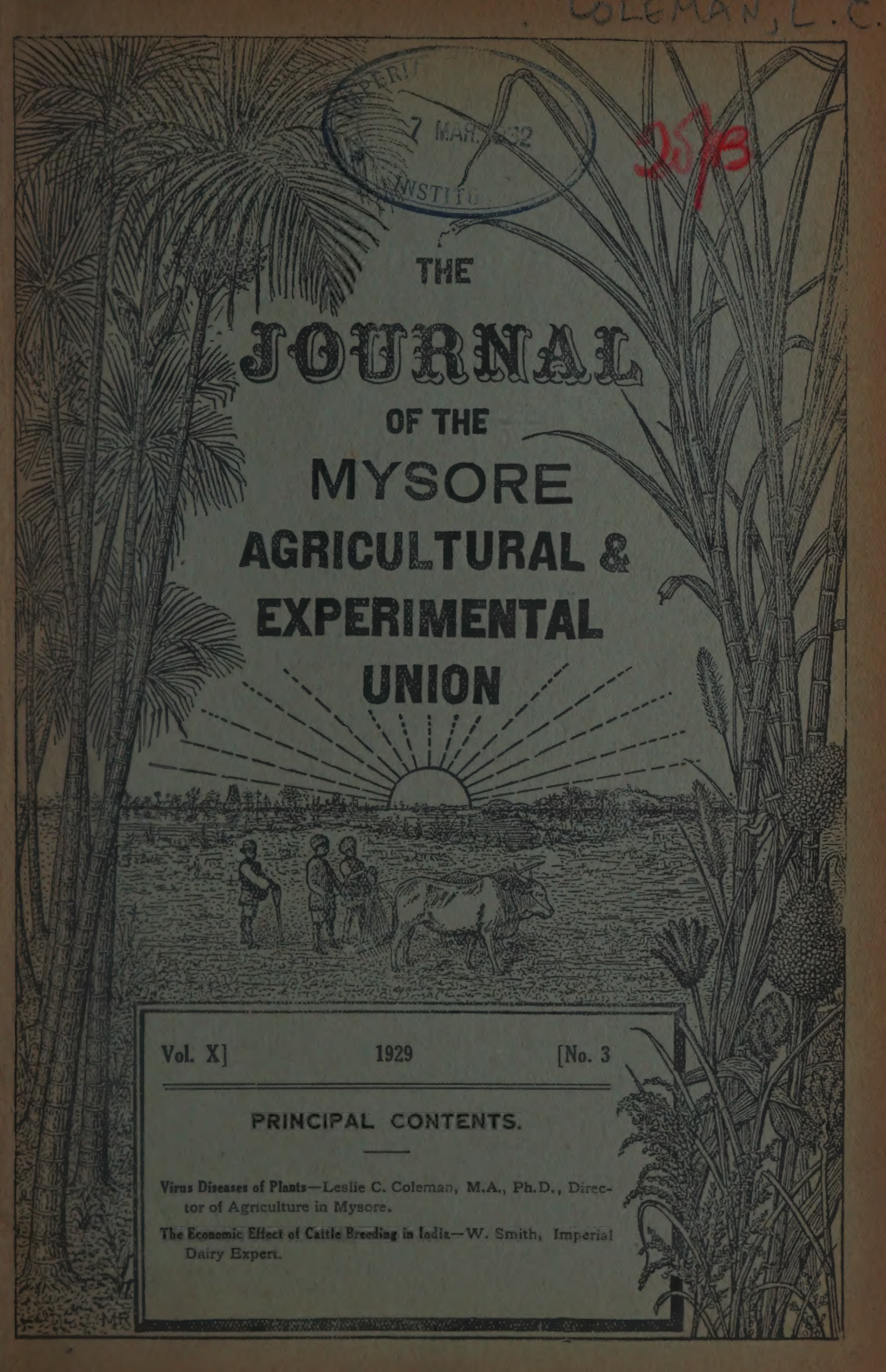
THE JOURNAL OF THE MYSORE AGRICULTURAL & EXPERIMENTAL UNION



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CONTENTS.

MR. D. G. RAMACHANDRA RAO
Assistant Director of Agriculture.

The Journal
of the
Mysore Agricultural
and
Experimental Union.

Vol. X. 1929. No. 3

Mr. D. G. Ramachandra Rao.

Mr. D. G. Ramachandra Rao retired on the 2nd June, 1929, after a service to Mysore of 36 years. Of these, 25 years were spent in the Agricultural Department.

He was the first Farm Manager of the Hebbal Farm, having occupied that post from the establishment of the Farm in 1906 to the year 1914 when he was appointed Assistant Director of Agriculture. As Farm Manager Mr. Ramachandra Rao had, under the direction of Dr. Lehmann, the important and difficult task of laying out the Farm for experimental purposes and I think it is safe to say that nowhere in India has such work been carried out with greater accuracy and care. We are to-day reaping the benefits of his conscientious work carried out under difficult conditions.

With the organization of the Agricultural Department in 1914 Mr. Ramachandra Rao was given the important and difficult task of organizing agricultural demonstration work in the four western districts of the State. For fifteen years he carried out this work practically without intermission.

During the last years of his service Mr. Ramachandra Rao had, in addition, the supervision of work in the Marthur Experimental Farm.

Few officers of Government can have had so long and continuous a service in the *malnad* as Mr. Ramachandra Rao and his knowledge of agricultural conditions in that part of our State is, I believe, unique. That we have been able to make substantial progress in what is looked upon as the most backward part of the State, is, to a great extent, due to his efforts.

My personal association with Mr. Ramachandra Rao has extended over a period of twenty-two years. He has been a model of loyalty and, though we have had many differences of opinion, I have continuously been impressed with his genuine patriotism and his desire, even at personal sacrifice, to advance the cause of Mysore agriculture.

With his retirement Mr. Ramachandra Rao will not cease to play a part in agricultural development. He has been chosen as a leader in what must be looked upon as a very interesting and important experiment. I refer to the Bhadra Colony. If this Colony proves a success, it will point the way for the utilization of the brains of this State for the development of what is now and is likely to remain our most important industry. Mr. Ramachandra Rao's new task is a fitting close to an honourable and useful career in the service of the State.

LESLIE C. COLEMAN.

Virus Diseases of Plants.*

BY

Dr. Leslie C. Coleman, M.A., Ph.D.,

Director of Agriculture in Mysore.

Plant Pathology or the study of plant diseases is, in a sense, one of the most modern of the applied sciences. So modern is it that it is still largely in the leading strings of the mycologist and, in fact, in India the term mycology is considered as synonymous with plant pathology. This is to be regretted because many pathological conditions in plants are produced by agents other than fungi, so the

* Address to the South Indian Science Association.

terms mycology and mycologist do not rightly indicate the nature of the work and the training required by an investigator of plant diseases. The person who is a mycologist and nothing more is, in fact, very ill-equipped for a study of the problems connected with diseases affecting plants.

In no field of plant pathology is this more strikingly illustrated than in the field of virus diseases, for whatever may be the character of the primary cause or causes of these diseases they cannot be attributed to the action of fungi in any usual acceptation of that word.

The use of the term virus as applied to the diseases of both animals and plants is really a confession of our ignorance, for it can be defined but vaguely. A virus, as we understand it to-day, is an element or principle of unknown origin and character which is the agent for communicating infection or infectious diseases. As common examples, more or less familiar to all, may be cited the virus of small-pox, the virus of rabies, the virus of rinderpest and the virus of foot and mouth disease. In the case of none of these diseases has it been possible as yet to isolate any organism which can be multiplied in pure culture and can thereafter produce the disease when inoculated into a healthy animal.

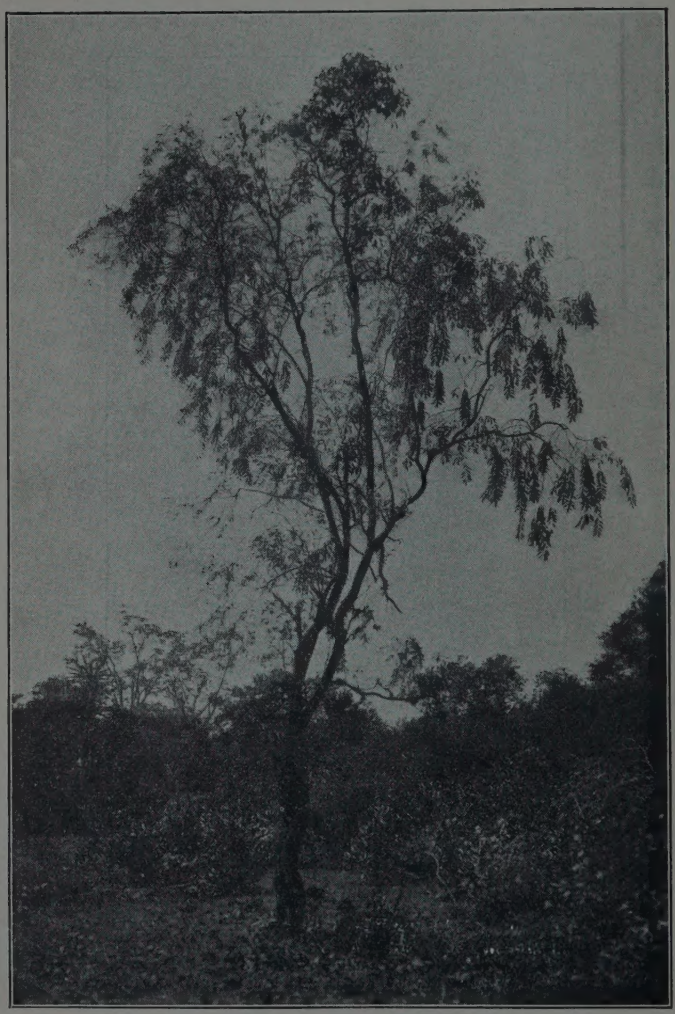
As is the case of diseases in general so in the case of virus diseases, those attacking animals and more especially human beings have received much more extensive and concentrated attention than those attacking plants. Nevertheless in recent years the economic importance of the virus diseases of plants as well as their absorbing scientific interest has led to a steadily increased attention being paid to them. As an example at our very doors may be cited the " Spike " disease of sandal which seriously threatens our most important source of forest revenue and which is at present under investigation by a considerable number of scientific workers in South India.

As the subject of my address to-night indicates, I shall not attempt more than a very general survey of the virus diseases of plants largely because my work is of such a character as to prevent my taking an active part in the investigation of any of these diseases. My reasons for dealing with the subject are threefold. In the first place there is no doubt that the virus diseases of plants are continually levying an increasing toll in the agricultural and forest products of the world.

In the second place there seems to be some connection between the virus diseases of plants and the more strikingly important diseases of human beings and domesticated animals; it seems, therefore, probable that continued investigation of the former may throw some light on the latter. The third reason is a personal one. While, as I have said, I have not myself in recent years contributed to our knowledge of these diseases—nor can I hope to do so in the near future—I have had opportunities of observing a goodly number of them in other parts of the world, such as have not been afforded to most workers in India. I should like further to preface my remarks by the statement that as I am a biologist, I shall confine myself to a consideration of the biological aspect of the question leaving a consideration of the bio-chemical and other aspects to those much better qualified than I in those fields.

The first virus disease of plants to attract scientific attention was the mosaic disease of tobacco and this may be used as a suitable starting point for our hurried survey of the field. This disease is present in all parts of the world where tobacco is grown including India though in this country it has not yet been studied. As the name indicates it is characterized by a mottled appearance of the leaves in which rather irregular areas of lighter green alternate with areas which show the darker green colour typical of healthy leaves. The lighter areas are at the same time somewhat thinner. Where the disease breaks out in a field it is almost always the younger leaves which show the symptoms. The disease is highly infectious in nature. In fact it can be transmitted by simply rubbing a diseased leaf between the fingers and thereafter rubbing the leaves of a healthy plant with the same fingers. The handling of tobacco in the field in the processes of topping and removing secondary shoots is considered in Sumatra to have been one of the regular means of spreading the disease. A microscopic study has revealed no fungus or bacterium which could be looked upon as the causal organism. The expressed juices are highly infectious even in very great dilutions (1 : 10,000). Even when this juice is filtered through a filter candle which prevents the passage of ordinary bacteria, it still remains infective. One of the most striking features of the infective principle is its resistance to drying out for long periods. I have personally transmitted the disease by

Tobacco mosaic showing mottled appearance of leaf having more light green areas than dark green ones. In addition, the leaf shows a peculiar crinkled appearance.



Sandal tree affected by spike disease. This type, showing a pendulous orientation of the affected branches, is met with occasionally.

grinding up dried diseased leaves, which have been kept in the herbarium for a year in distilled water and injecting the extract by means of a hypodermic syringe into healthy plants. Others have found such dried leaves infective after preservation in an herbarium for over twenty years.

The filterable nature of the virus is characteristic not only of this disease but of a large number of virus diseases of both plants and animals. However, that it is intimately associated with particles which are very large as compared with, for instance, a molecule of water is shown by the fact that filtration through the finer filters such as those made of celloidin leads to a filtrate which is no longer infective. An attempt has been made to measure the size of these particles by comparing their filterability with that of colloidal particles of which the size has been more or less accurately estimated. In this way Duggar and Karrer have come to the conclusion that the particles carrying the virus of tobacco mosaic are approximately of the same size as the colloidal particles of 1% hæmoglobin or 30 millimicrons. Such particles are far below the limits of visibility with the most powerful microscopic magnifications. To give one an idea of the size of these particles relative to that of bacteria it may be stated that half a micron is about the lower limit for the diameter of known organisms such as micrococci. In other words these particles seem to have a volume not more than 1/4000 of that of our smallest bacteria. As a matter of fact, however, the method of judging size by ultrafiltration, is so beset by pitfalls, such as those associated with absorption and electric charge, that any estimates of size made by this method must be accepted with a great deal of reserve.

Another striking feature of the virus of tobacco mosaic in which it resembles many other plant and animal viruses is its marked resistance to disinfectants. Thus it can withstand concentrations of alcohol, thymol, corrosive sublimate and other disinfectants which are far in excess of that required to kill bacteria except when they are in the spore stage. These two characteristics of viruses, *viz.*, small size and great resistance to disinfectants, have been used as arguments against the supposition that we are here dealing with living organisms. As to size, no one knows what the lower limits of size for living organisms are: as to resistance to disinfectants, Olitsky has recently shown

in his studies of Foot and Mouth disease that this resistance is not a real one but is due to the association of the virus with protein materials which serve as a protection, through their coagulability or their electric charge or both. Thus the virus was found highly resistant to such coagulating disinfectants as corrosive sublimate whereas to such non-coagulating disinfectants as antiformin and sodium hydrate it was just as susceptible as living micro-organisms such as staphylococci. It seems probable that the observed greater resistance of virus extracts in general to certain common disinfectants is not due to any greater resistance in the virus itself but to the protective action of the proteins from which it has in no case, up to the present, been separated.

For a long time it was considered that there was one and only one disease of tobacco included under the designation mosaic. Work of the past four or five years, however, has indicated that this is not the case, but that there are a large number of such diseases. One author claims, for instance, that tobacco is susceptible to no less than six distinct strains of mosaic virus. A Dutch scientist has quite recently discovered and described a new virus disease of tobacco in Sumatra distinct from the common mosaic. Similarly workers on mosaic of potato have reported as many as eight strains of mosaic virus on that plant. These strains are distinguished by the different symptoms they produce, their different reactions under varying temperature conditions and by the fact that in some cases the inoculation of a plant with two different strains has led to symptoms very different from those produced by either, when used separately.

A very similar state of affairs has quite recently been found in the case of Foot and Mouth disease of cattle where these strains have been found. Here, the differentiation is on perhaps a surer basis, for Vallee and others have shown that an animal after being attacked by one type of Foot and Mouth disease and having acquired thereby the temporary immunity of about 4 weeks that results from attack, is immediately susceptible if inoculated with one of the other two virus strains. It is quite possible that this condition occurs in the case of other virus diseases as well. This is a possibility which we shall have to keep in view in our investigations of Sandal Spike.

It must be clear that the method of disease transmission already

described is one that does not usually occur in nature, for while in the case of mosaic diseases of economic plants transmission through the handling or rubbing by human hands or through the use of cultivating implements or pruning tools might be possible, this could hardly be a factor in the case of the mosaic diseases of wild plants. Investigators, therefore, very early sought for some other factor in disease transmission. The most natural place to look for such a factor was in the insect world and as a matter of fact, it was here that it has been found and among those insects which obtain their nourishment by sucking up the juices of plants such as mosquitoes suck the blood of human beings. In a very large number of the mosaic diseases transmission through sucking insects such as plant lice and leaf hoppers has been established and the insect vector has also been demonstrated in a number of other virus diseases as well. I shall refer to this later on.

Transmission of virus disease through seed from diseased plants has been established in only a very few cases. It does not occur, for instance, in tobacco mosaic, nor does it apparently occur in the case of Sandal Spike. Transmission of disease through the soil has not yet been established in a single case, so I think we may take it that this sort of transmission must be rare indeed.

Lastly there are quite a number of virus diseases in which transmission has been brought about only through grafting a scion or bud from a diseased plant on to a healthy stock and as you are aware, Sandal Spike and a number of similar diseases found in South India belong to this group. We know, however, that these diseases spread in nature where no such grafting takes place. Therefore there must be some other means of transmission. It seems highly probable that insects are responsible in the case of these diseases also.

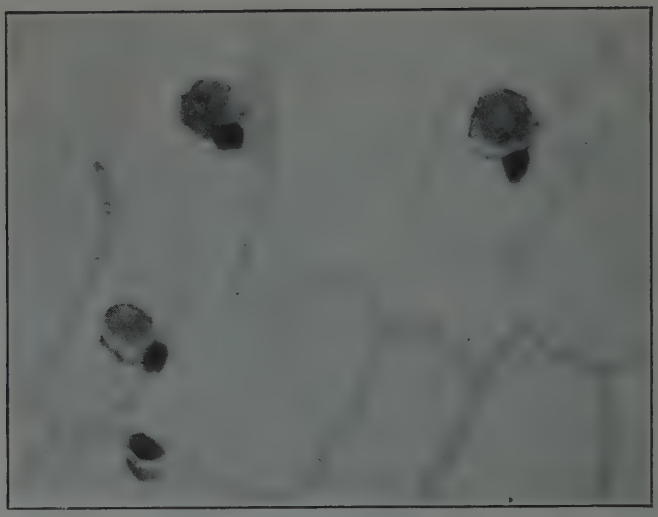
In respect of insect transmission, virus diseases of plants resemble many human and animal diseases such, for example, as plague and malaria. The question naturally arises whether the insect vectors are simply the carriers of these virus diseases or whether the virus must pass through a stage in the insect itself before it is able to infect a healthy plant, similar to the conditions we find in malaria.

One of the most interesting pieces of work on virus diseases of plants (that by Kunkel on Asters) throws a most interesting light on

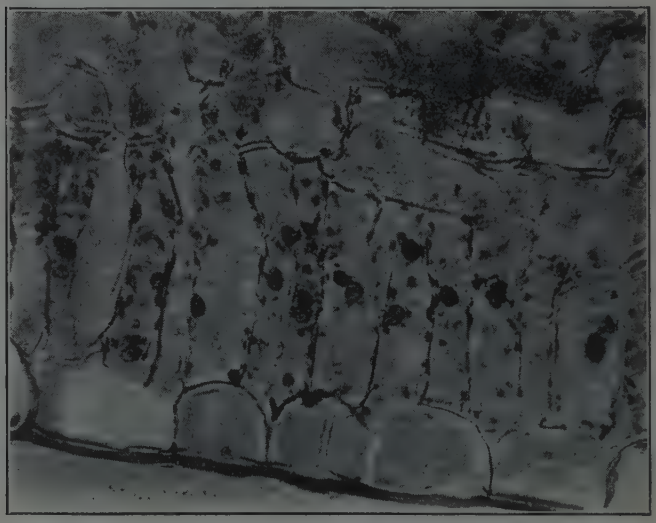
this very question. Kunkel found that the disease known as Aster Yellows which attacks the China Aster and a number of other plants is transmitted by a leaf hopper *Cicadula sexnotata*. He found further, however, that infection did not take place if an interval of less than ten days elapsed between the time when the insect fed on the diseased plant and the time when it fed on the healthy plant. In other words, an incubation period of ten days has to elapse before the Cicadula becomes infective. A similar but shorter incubation period has been established in the case of three other virus diseases: the curly top of sugar beet, the streak disease of Indian corn and the leaf roll disease of potatoes. One is almost tempted in these cases to draw an analogy with malaria and one can hardly escape the conclusion, in the case of Aster Yellows at least, that the virus does develop in the insect. The important experiments of Kunkel seem to me to furnish the most convincing evidence yet advanced that we are here dealing with a living organism. It is almost inconceivable to me that an unbalanced sap circulation or a plant enzyme out of control or a lethal gene escaped from the plant cell could propagate itself in the body of an insect. I need hardly point out that Kunkel's work greatly complicates the problem of insect transmission, for we shall have not only to seek out from among the large numbers of insects which are found on, for example, the sandal tree the one insect which is capable of transmitting the disease, a difficult job in itself; we shall also have to take into account the possibility that even that one insect may not be capable of transmitting the virus till the latter has passed through an incubation period of unknown duration in the insect's body.

While I must point out to you that the views of workers on virus diseases are very divided on the subject of the nature of the virus, there seems to me no escape from the conclusion that in a large number of these diseases at least the virus is a living organism. As I have already stated, in no case has any organism yet been observed which on inoculation could produce any one of these diseases. However, evidence is steadily accumulating in connection with virus plant diseases that certain definite structures are present in the cells of diseased plants which are not to be found in healthy ones. While there is as yet no valid evidence that these bodies are themselves the organisms of the virus (they seem much too large for that), there are

Periwinkle (*Vinca rosea*, L.) showing the lower branches affected by spike disease, the top ones being apparently healthy.



Photomicrograph showing vacuolated intracellular bodies attached to the nuclei present in the cells of a spiked sandal leaf. The intracellular bodies are large, the nuclei smaller and dark coloured.



Photomicrograph showing the intracellular bodies in the cells of a spiked Vinca leaf. In the middle of the photograph one is shown attached to the dark coloured nucleus.

workers who believe that they are either stages in an organism which has also an ultramicroscopic stage or that they hide within them the ultramicroscopic organism which causes the disease. To my mind the most important recent contribution to our knowledge of Sandal Spike has been the discovery by Mr. M. J. Narasimhan of the presence of intracellular bodies of this character in diseased sandal leaves as well as in the leaves of vinca suffering from a similar disease. Mr. Narasimhan has been good enough to allow me the use of some of his micro-photographs here.

I trust that the very hurried and imperfect survey which I have been able to present to you will convince you that we are here dealing with a subject of immense practical and scientific importance and that the investigation of our very important virus diseases of plants demands the very best in brains and investigating genius that this country can produce.

It would perhaps be going too far to speculate upon the possibility of coming, through a study of these diseases, to a knowledge of the most elemental forms of life existing on earth. Whatever the cause of these diseases may be, if it is a living organism it is one that cannot live by itself. It is, in other words, an obligate parasite whereas the most primitive forms of life must be organisms which can live free. There is also the possibility of our having to do here with organisms whose structure has been degraded and simplified through their parasitic mode of life. Who is to say, however, that there are not free living organisms to-day which are similar in their minuteness and their simplicity of structure to those which we believe to be the causes of virus diseases? If such exist, they stand very close to the line separating the animate from the inanimate world.

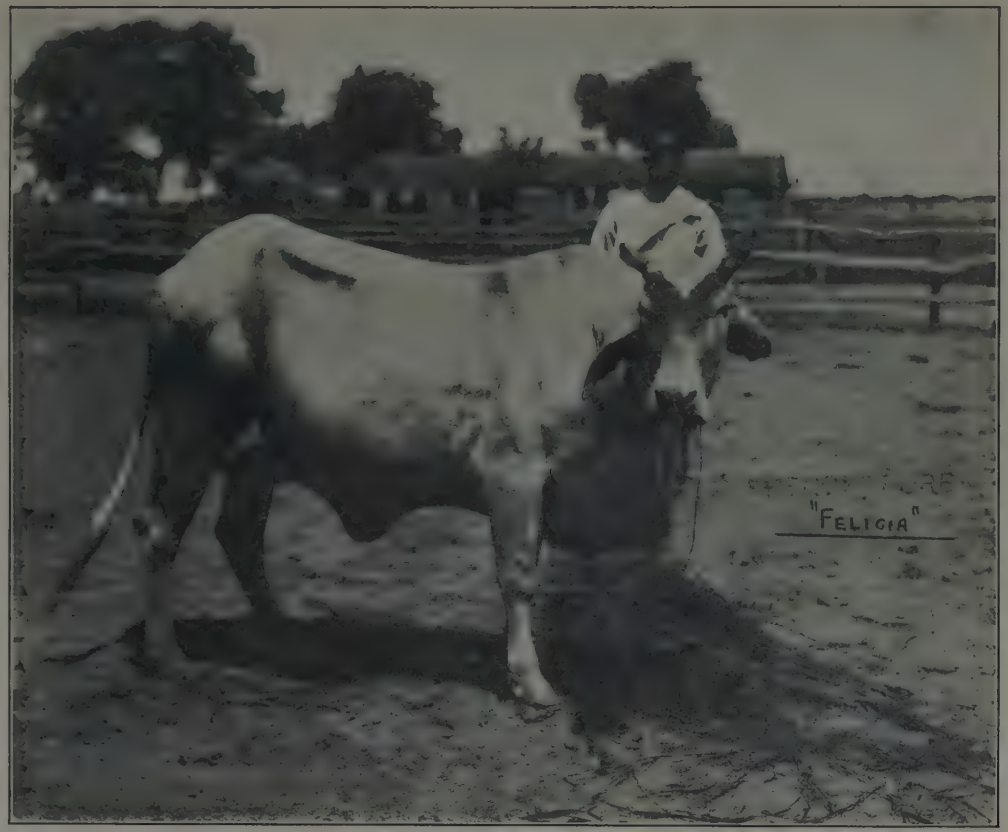
Before proceeding to the consideration of the lantern slides you may wish my views as to the lines of future work which are most likely to lead to practical results in the control of these diseases. Apparently they are in many, if not most, cases insect-borne and a control of their insect vectors must always be kept in view as a means of controlling the diseases themselves. This, as you know, is the most effective means of controlling many of our insect-borne human and animal diseases. However, in the case of plants where the economic factor is much more prominent than in the case of human diseases,

at least, I believe that our chief hope for the future lies in the discovery of, or the breeding of, resistant varieties. Much progress has already been made in this direction in connection with quite a number of the virus diseases of plants and while the breeding of a sandal strain resistant to spike will probably be very difficult, still it seems to me to be our chief hope for the future.

The Economic Effect of Cattle Breeding in India.

Under the auspices of the South Indian Science Association a lecture was delivered at the Central College on 27th August 1929, by Mr. William Smith, Imperial Dairy Expert to Government of India. Dr. Leslie C. Coleman, M.A., PH.D., Director of Agriculture in Mysore, presided and there was a large attendance, the hall being crowded in every part. The subject of the lecture was "The Economic Effect of Cattle Breeding in India" and Dr. Coleman in introducing the lecturer to the audience referred to his long connection with cattle breeding in this country. Dr. Coleman stated that he had known Mr. Smith for over 20 years and that when he was in doubt as to any question concerning the breeding or management of cattle he referred to Mr. Smith. Dr. Coleman called attention to the great importance of cattle breeding as a national industry and to the increased attention which it was getting from his Government and from all Governments in India.

In opening his remarks Mr. Smith stated that in the time at his disposal he would only be able to awaken the attention of his audience to the subject and in order to do this he would refer to reasons why the cattle breeding question is such an important one for India, and the first reason he gave was the fact that India owns more cattle than any country in the world, not only does India stand first of all the nations in regard to the numbers of horned cattle which she possesses, but she maintains more cattle per hundred acres of cultivated land than any other country in the world. Holland is the European country which is credited with possessing the largest cattle population and Egypt may be taken as a country the agricultural conditions of which are similar to India in many respects. The numbers of cattle kept by these three countries per 100 acres of cultivated land are :—



Saniwal Cow—Felicia, bred by and the property of the Military Dairy Farm, Ferozepore. The best pure Indian cow alive. Gave 11,448 lbs. milk in 365 days.

Scindi Cow—No. 721, Bangalore Dairy Farm, gave 7,272 lbs. of milk in best lactation.

India	.. ..	67 per 100 acres.
Holland	.. ..	38 ,, ,, ,,
Egypt	.. ..	25 ,, ,, ,,

The total value of the cattle of India including Indian States if taken at the very low average value of Rs. 25 per head is not less than five hundred crores of rupees.

Then secondly, the lecturer pointed out that the cultivation of every kind of crop in every part of India depends upon the efficiency of the working bullock and a really efficient bullock cannot be produced except from a healthy and well-fed cow. India is not only a country of small holdings, it is a country of sub-divided small holdings, of fragmented holdings, and land divided up in this way cannot economically be cultivated by the use of mechanical tractors, nor are horses, mules, donkeys or camels suitable for field work under Indian climatic conditions, so that, as the Royal Commission on Agriculture state in their report, cultivation in India must be done by the ox. The increase in food production and the consequent increase in the wealth and general well-being of the country which can be brought about by the use of new and improved varieties of crops, by the adoption of improved and more efficient machinery and implements for cultivation, seeding, manuring and harvesting of crops is dependent very largely on the efficiency of the work-bullocks, as without strong and well-trained cattle new and improved modern farming machinery cannot be utilized and without improved machinery the country cannot make the best possible use of improved cropping plants nor increased irrigation facilities. Then India needs to make use of cattle manure as a fertilizing agent much more than is done at present and the improved feeding which would be given to better cattle would improve the quality of the cattle manure available. Artificial manures are becoming more used in India as the century advances but these can never altogether take the place of ordinary cow-dung which, apart from its chemical properties, is required to keep the soil in the best possible physical condition for cultivation.

The lecturer then went on to point out the importance of the cattle question from the point of view of the milk supply of the nation. With a cattle population greater than any other country in the world one might imagine that India had the finest and cheapest milk supply

of all countries, but owing to the poor quality of our cattle the exact opposite is the case. The urban milk supply of India including that of the larger villages is certainly inadequate, expensive and altogether unsatisfactory. As a proof of this the lecturer referred to the fact that although the selling prices of such ordinary articles of food as eggs, rice, pulse, sugar, flour, etc., in Bombay, Calcutta and Rangoon were lower than in most of the world's large capital cities, yet the price of pure milk in these three Indian cities was very much higher than the current rates now being charged in London, Berlin, New York or Melbourne.

India is a vegetarian country and the great mass of the people eat animal fat only in the shape of the milk fats. The peculiar growth-aiding vitamins found in the animal fats are now recognized as necessary for children and young persons and as we in India only use these in the form of milk fats, it will be seen how important the milk supply problem is from the point of view of the health, stature and general physical well-being of the community. The reason why milk is so scarce and dear in India and why the various milk products ordinarily eaten by the people like ghee are so much adulterated is the poor quality of the cows of the country. The cattle question in India is a dairy question. We do not kill and eat our surplus cows nor do we put our cows to field work. In order, therefore, that our female cattle stock will earn the cost of their keep they must be efficient milk-producers as well as the mothers of the next generation of strong work cattle. The country cannot afford to keep all the cows which will be born merely to produce work bullocks, they must at the same time be milk producers over and above what is necessary to rear their calves.

The lecturer then referred to the veneration in which the cow is held by the Hindus and to the fact that in India unlike all other countries of the world cattle were not eventually killed and eaten and because of this sentiment India is called upon to support a large number of old and useless cattle entailing a heavy drain on the economic aspect of the wealth. Mr. Smith pointed out that the only way to overcome this was to breed only efficient cattle either as milkers or workers as the country could afford to keep animals until death which in their prime had earned their living by efficient work as plough bullocks or milkers.

Mr. Smith then called attention to the fact that 82% of the people of India are agriculturists and that the working capital of practically all the agriculturists in the country is invested in bullocks or milch cattle and in order to make this capital dividend-earning, a greater efficiency in working cattle and milk cows was absolutely essential.

The lecturer next pointed out the value of the cattle-breeding dairying industry as a means under the co-operative movement of solving the problem of village unemployment and providing a village dairy industry throughout the land. He called attention to the fact that in all small holding countries throughout the world the co-operative movement had been eminently successful in its application to the dairy industry, and that in all these countries the organization of the sale of milk and manufacture and sale of milk products had preceded the great improvement of dairy cattle. The cow must always be the source of supply of the work bullock and as the people of India do not eat the flesh of the cow and do not use her for field work she must be utilized as a milk-producer as well as a breeder of bullocks. In order to get the cow-owner to take more interest in his cow to breed her more carefully and feed her more bountifully he must be brought to realize, by means of co-operative organization for purposes of sale and manufacture, the value of her produce.

At the close of Mr. Smith's address there was a lively discussion in which, among others, Mr. N. Krishnaiengar, Dr. C. B. Rama Rao and Mr. H. R. England took part. Mr. Krishnaiengar raised the question as to what could be done to prevent the slaughter of cows which had been brought to towns when in milk. Mr. Smith pointed out that the way out of the difficulty was to keep the cows in the country and to transport the milk to the towns. In this connection he drew attention to the fact that sixty years ago cows used to be kept for the supply of milk in the large cities of Europe. Now none could be found in the cities. A similar change will have to occur in India if we are to place our milk supply to towns on a proper foundation.

Mr. England raised the question as to the possibility of organizing milk supply on a co-operative basis in India under present conditions. Mr. Smith pointed out that a very promising beginning

had already been made in this regard. For example he mentioned the flourishing co-operative milk supply societies in Calcutta and Madras and also referred to the promising start that had been made in this connection in the Kolar Gold Fields. He believed it should be quite possible to organize a similar society in Bangalore. It may be mentioned in this connection that the Registrar of Co-operative Societies is at present having an investigation made as to the possibility of organizing a society in this city.

The Steel Plough.

BY

Gundappa S. Kurpad, B.A.,

Vice-Principal, Mysore Agricultural School.

One of the very first recommendations that are made for the improvement of agriculture in our parts has been the use of the steel plough. This recommendation is so common that everybody has come to accept it more or less as the starting point of improved agriculture. The recommendation can be very strongly supported from a theoretical point of view. It would thus be easy to prove that the steel plough or the mouldboard plough does better and more work than the ordinary wooden plough. The point whether the better work turned out by the steel plough really results in better yields and bigger profits, is one on which more than one opinion is held. We see, no doubt, increasing sales of the steel plough which fact may lead us to suppose that the farmers are realizing that the money spent on the steel plough is really well spent. Although much has been said about the innate conservativeness of the Indian farmer, yet competent observers have noticed that he is not slow to take advantage of improvements which he is satisfied are improvements.

There is sometimes noticed, a very curious way in which the efficacy of the steel plough is demonstrated by certain farmers. They seem to have realized the advisability of using the steel plough and also that certain parts of it require constant renewal. Not being used to such renewals, they want to make the wearing parts last as long as possible, with the result that the steel plough is used very sparingly. To a large extent, therefore,they still depend on their country ploughs. With all this, they cannot get rid of the idea that the steel plough is

really capable of giving good results, although the exact action of the plough is something beyond them. This confusion in their minds leads to their often ploughing their lands with both ploughs simultaneously. It is rare to see only one plough working on a field. The common practice is for two or more ploughs working together one following the other. One of such ploughs is replaced by the steel plough, the idea evidently being that the steel plough by its mere presence is somehow going to benefit them. One can easily see that using the steel plough in this way is not likely to be of much use.

Another recommendation that is also made with regard to ploughing is that lands ought to be ploughed soon after harvest, wherever that is possible. This practice has not yet been sufficiently stressed and brought to the notice of farmers. Here again it may be that the benefits of such a practice, although it can be defended and recommended on theoretical considerations, have not been practically demonstrated sufficiently.

With a view, therefore, of getting definite figures about these two very common recommendations, experiments were started a few years ago on the Hebbal Farm. It took us some time to settle down to a simple scheme which would give us the required information. The experiment has been running only for three years and does not warrant our drawing any final conclusions from it. Even here, we have had to change the plot for the experiment last year and strictly speaking, the present experiment can be said to have run for one year only. Yet the results that have already been obtained are interesting, and these indicate that there may be a sound basis for the recommendations that are usually made. The results are :—

Nature of Experiments	*Yield per acre in lbs.*	
	GRAIN	STRAW
1. Check-Spring ploughing with country plough	1,218	1,658
2. Spring ploughing with improved plough (Mysore plough)	1,390	1,683
3. Autumn ploughing with country plough.	1,117	1,443
4. Autumn ploughing with improved ,, (Mysore plough)	1,398	2,048

Superficially, these results would seem to be a complete vindication of the practices recommended, but caution must be our watchword and we have yet to see if the differences will go beyond what might merely be due to experimental error.

Experiments of a similar kind were conducted on the Hebbal Farm during the years 1909 to 1914. Comparison of autumn ploughing with spring ploughing was made on one plot and the comparison of the work of the steel plough as against the country plough was made in another plot. Both these are combined in one plot at the present time. The results obtained previously seem to point in the same way as the indications now obtained, but they seem to be more conclusive.

TABLE I (Giving weight of grain).

Time of ploughing.	1909	1910	1911	1912	1913	1914	Average of 6 years.
Ploughing after harvest	940	755	755	642	557	900	758
Ploughing before sowing	640	445	235	315	287	375	382

TABLE II (Ploughing before sowing).

Kind of plough	1912	1913	1914	Average
Steel plough	660	875	390	642
Country plough	650	380	367	466

Putting this aside, there are other points which must be considered when we begin to compare the work of the steel plough with that of the wooden plough. During the course of this experiment, we have found that the plots which are ploughed with the wooden plough tend to get very weedy. Again, we have found that during seasons of unfavourable rainfall, the plants on the plots ploughed with the steel plough stand up against drought very much better than those in the other plots. So that, even if there may actually be no appreciable increase in yield by the use of the steel plough, yet the lower expenses for weeding the plots and, what is of greater importance, the ability of the plants to tide over a bad season, are reasons enough for the more extended use of the steel plough.

A word may be said here about some of the obstacles that are said to be in the way of the more common use of the steel plough. The first is the question of cost. While it is an undoubted fact that many of our farmers are poor, still it must be granted that many more have the capacity to purchase a steel plough than have actually done so. When considering the question of cost, the cost of the

bullocks required for using these ploughs must also be taken into consideration. It is a common place to say that the draft of the steel plough is too much for the ordinary bullocks. Here again, it must be admitted that while many farmers do not own cattle big enough for the steel ploughs, yet many of the farmers who do own good and strong cattle are still content to use the wooden plough. It is a mistake to suppose that very strong bullocks are required for the steel plough. Medium-sized bullocks, such as we most commonly find in all the *mzidan* villages, are quite capable of handling the ordinary steel ploughs. Further, there are steel ploughs of various sizes to suit various sizes of animals and it is merely a question of taking some trouble to find a plough suitable to one's needs.

There is also the question of cost involved in replacements to which we must also add the ease with which spare parts are available. About the first, a certain amount of work has been done by the Department and the plough recommended by the Department reduces the cost of replacements considerably. Recently there has been a considerable reduction in the price of the ploughs themselves and this ought to make the extended use of these ploughs easy. If a campaign for the rapid spread of the steel ploughs is to be a success, two things are absolutely necessary. Firstly, there should be a conviction in the minds of the propagandists that the recommendation they are making is based on facts, not on mere imagination. It is only, then, that they can carry conviction to others. Secondly, every attempt should be made to prove the efficacy of the steel plough, to prove that the arguments usually adduced against it are not really strong, and to give definite ideas about it to the farmers. In any case, such work is bound to be slow, but if the work is done on the lines indicated above, the results are likely to be lasting, and what is more, an intelligent interest is likely to be created in the implement, leading to its more extended use.

Village Panchayats and Agricultural Improvement.

BY

B. R. Gururaja Rao,

Agricultural Inspector.

It is a well-known fact that the agricultural industry is the mainstay of India, and especially so, of our own State, where 75% of the population live by it. The importance of this primary industry is so well recognized that our benign Government have been trying their best to improve the economic condition of the Mysore farmer in all possible manner.

Though the staff of the Department has been continually at work, carrying the gospel of agriculture and improved methods to the very door of the ryot by holding demonstrations, lectures, etc., yet for various reasons many of the interior parts of the State have not been touched. Rural reconstruction and advancement of the village has been the main ideal of our present Dewan Saheb and he has been sparing no amount of pains and expense on that account. Thus the Village Panchayat Scheme has been introduced, which, if worked on proper lines, will be to the benefit and advantage of every village where people themselves are allowed to manage the greater part of the village administration so as to attend to it more easily and speedily, being interested in the well-being of their village and living always in the midst of their people.

Each village panchayat comprises a group of 2 or 3 hamlets and a few of the intelligent representatives of the villages concerned form the body called the panchayatdars. These are required to manage all the needs of the villages in their charge. The whole revenue of the village is in their own hands and they have the privilege vested in them to spend the amount for the benefit and uplift of their village to the best advantage. Thus Government have conferred a great boon by instituting this scheme to improve the village on all sides, and bring it to the level of cities and towns within a few years. Several items of work have to be taken up and worked under a Rural Reconstruction Scheme so-called to attain this end of village improvement. Out of these the first and foremost is improvement of agriculture which is the bread-giving profession of every villager.

I venture to give below certain suggestions for the improvement of agriculture and how these village bodies can carry on the work to their best advantage.

1. *Introduction of Improved Implements.*—Each of the panchayats can safely invest about Rs. 40 out of their collections on an iron plough and a cultivator and arrange to give them out on hire in the season for a small fee; and the amount of hire can be used for renewal of plough shares and other petty repairs whenever necessary. Rich panchayats can, when it is advisable and profitable, invest in bigger labour-saving machinery such as tractors and threshing machines, etc., which will be beyond the reach of an ordinary ryot.

2. *Improved strains of pure seeds.* The total requirements of the whole village can be purchased for sowing at cheaper cost, and, at the same time, ensuring the genuineness of the variety. This, in most cases, may not be quite easy for an individual ryot. Arrangements for trial of new varieties of crops can be made with success on a fairly large scale.

3. *Artificial fertilizers and oil-cakes* can be similarly bought and supplied to the villagers at wholesale rates, and a great deal of unnecessary extra expenditure avoided.

4. Arrangements can suitably be made for the proper conservation of ordinary farm-yard manure in decent pits specially made for the purpose on a common public site, one in each of the village householder's name and the daily refuse from his cattle yard removed to his pit properly. By this, the unhealthy practice existing now of having manure pits almost anywhere and everywhere in the village, causing so much of insanitation, can be done away with and at the same time making well preserved cattle manure available to each farmer. The village cattle-pound refuse can also be put separately into a pit and the manure can be auctioned out for the benefit of the villagers.

5. *Cattle-Breeding Work.* A good breeding bull can be purchased and maintained for the use of the village arranging at the same time for the castration of all the scrub bulls and bull calves being done satisfactorily. In this connection I may suggest that each panchayat

can own a "Bloodless Castrator" for itself and train its own men to do the work more promptly and easily without having to wait for the departmental people to do this. They can even charge a small fee for castrations and for the service of the breeding bull and add the income on to the panchayat fund.

6. *Checking cattle diseases and diseases of plants.* The panchayats can even own certain country drugs and medicines, whose uses are well known and attend to the ordinary ailments of their cattle in time. In the case of more serious pests of crops and contagious diseases of cattle, the departmental help can be sought for and more readily got when communicated through a body like the panchayat than by an individual ryot.

7. *Irrigation and drainage works* can be undertaken and done to the advantage of the village as a whole, such as deepening of tanks and *nallas* so as to provide suitable irrigation facilities for their crops and drinking water for their cattle and themselves. Tank silts, etc., can be profitably used as manure for their crops.

8. *Care of gomal lands, village forests and thopes.* Panchayats can attend to the proper management of these so as to afford enough and suitable green fodder and grazing for their animals and sufficient leaf manure for their crops. *Honge thopes* can be arranged to be raised with advantage for leaf manure. The extra quantity of grass and other fodder can be easily preserved in a common silo-pit or good fodder grasses can even be profitably grown on gomal lands and put into the silo-pit to tide over some unforeseen fodder scarcity and distress.

9. *Purchase of all the requirements of the village, i.e.,* seeds, manures, etc., can be profitably made through the panchayat, and arrangements for the combined sale of all the produce of the village could also be advantageously done, thereby saving a lot of the middleman's and broker's profits; it is a well-known fact that an individual villager does not at all get full value for his money when he purchases his requirements, nor does he get adequate value for his produce when he puts it on the market himself, owing to the intervention of these ever busy middlemen of the towns and cities.

10. *Village Dairies.* Most of the milk and curd supply of cities and towns comes from villages, but it is really pitiable that

the producer does not get the proper price because the professional dairy men of cities and towns go about the villages and buy all the milk and curds at cheaper rates and make abnormal profits by the sale of whole milk or by making it into butter or ghee. The village panchayats themselves, wherever it is possible, may arrange to have their own dairies and make more profit than what they are doing at present. The ryot is losing all this valuable money by selling away his milk to these professional men of the town who, without the slightest amount of trouble of maintaining dairy animals and looking after them, are able to get the dairy man's profits at the expense of the villager. Other suitable and small cottage industries allied to agriculture can also be taken up with advantage.

11. *Rural Education.* In their village schools they should have small garden and field areas where children should be taught simple agricultural lessons thus creating in the minds of the younger generation of the village, a love for the profession from the very commencement. Nowadays the village boys who migrate to the towns and cities for education are so fascinated with city life and its glamour that, when they return to their own village they usually have the least liking for their own life-giving profession. Simple lessons should be given in all village schools from the very beginning so that the boys and girls might cultivate a love for their native village and the sacred profession, cultivate a certain amount of pride for things rural from the very early years of their life. Scholarships for agricultural training can be provided for by the panchayats and the trained candidates may be required to come and work in their own villages after their training for the benefit of the villagers.

There are ever so many items of work on which the panchayats can lay their hands on profitably and they can have no greater ideal than the advancement of their village in all directions. If the village bodies can make up their minds at least to take up some work under each of the above lines and make a beginning as far as their revenue would permit, I can assure them that their economic condition is bound to improve, and it will be to their glory that these organizations in their own humble manner will be solving the great problem of unemployment, to some extent, by affording opportunities to people for some sort of profession and engagement.

The benign Government of His Highness the Maharaja of Mysore have afforded plenty of facilities for the economic uplift of the villages and it now rests with the village bodies to take advantage of the opportunities given. Government have been spending more money this year again on more panchayat inspectors and agricultural staff, etc., for the benefit of the villages. I conclude with an appeal to the several village bodies to take up work on the above lines, always looking to the interest of the village as a whole in a self-sacrificing spirit; to-day you will be serving in a smaller atmosphere in your own hamlets; to-morrow you will have ample opportunities to serve your native country and you will be the real sons of our beloved Mysore and the Mysore Soil.

NOTES AND COMMENTS.

Linseed Oil as an Adhesive for Bordeaux Mixture.

Ever since the time that spraying against coffee and areca diseases was introduced by the Department in Mysore, experiments, alike in the laboratory and the field, were being conducted with the object of finding out a cheap and efficient adhesive for use with the spray mixture. The use of an adhesive is necessary owing to the advantage that it not only helps in the uniform spread of the mixture over the sprayed surface, but it prevents the mixture from being washed off by the heavy rains. If it were not for the use of an adhesive with the mixture, spraying work in the malnad before the monsoon, over large areas of coffee and areca would be much less efficient in its results. By using a good adhesive there is not only economy in the quantity of materials used in spraying but also necessarily of a good deal of time and labour.

Very successful results have been achieved hitherto by using lime caseinate as an adhesive.* This adhesive has been taken up by most of the areca garden-owners and coffee planters and has practically displaced the resin-soda adhesive originally advocated by the Department.

Preliminary trials in the use of linseed oil as an adhesive in the spray mixtures were made during the monsoon season at Talaguppa. The oil was added at the rate of four fluid ounces to each pound of solid matter contained in the mixture. To 2% bordeaux containing 5 lbs. copper sulphate, 5 lbs. lime, 25 gallons of water, forty ounces of oil were added. The mixture was well stirred and sprayed on glass plates and, after drying, placed outside in the heavy rains. At the same time mixtures, to which only twenty ounces and ten ounces of oil were added, were sprayed on glass plates and subjected to the heavy rain.

After some time during which twenty-six inches of rainfall were recorded, the mixture was found to be adhering alright to the plates.

* Narasimhan, M. J.: "Casein as an adhesive in Spraying against Areca Koleroga."—*Journal of the Mysore Agricultural and Experimental Union*, Vol. V, No. 1.

The following proportions were tried :—

Bordeaux	*Oil added*	*Mixture on glass plate*
5.5.25	40 ounces	Intact.
5.5.25	20 ounces	Do.
5.5.25	10 ounces	Do.
5.5.25	20 ounces	Do.
5.5.25	10 ounces	Do.

Casein bordeaux and bordeaux without any adhesive were also used for comparison. When the oil was added to the mixture it was found that the excess oil floated to the surface. The quantity of linseed oil to be used has no bearing to the quantity of water used in the mixture, but it has a relation to the quantity of solids used. Preliminary trials of spraying on arecanuts and coffee leaves were found to be very promising. When compared to casein bordeaux, it was found that the linseed oil bordeaux was not so easily dislodged. Further experiments are under way to see how this mixture will work under field conditions. [M. J. N.]

Note.—Since the above was written, reports have been received that spraying with Linseed oil-bordeaux on areca trees in the malnad, and on coffee, has given promising results.

SELECTIONS.

Fireproofing Thatched Roofs.

Recent cases of fires, which have been attributed to sparks setting light to thatched roofs unusually dry owing to the drought, have directed attention to methods of rendering the thatch less inflammable. The Rural Industries Bureau, in a reference to this matter, states that a simple way is to whitewash the thatch when it is thoroughly dry, but of course this spoils its appearance. Of the other methods, the cheapest and easiest is to soak the thatching material for a day or two before use in a bath made of from 30–50 gallons of water to which from 1 lb. to ¾ lb. of alum and a similar quantity of sulphate of copper have been added. These two substances should first be dissolved in a little hot water and then mixed in with the cold water. The straw, heather or reeds should be loaded with weights to keep them under the water whilst soaking, and when taken out they should be thoroughly dried before being used. —*The Live-Stock Journal*, Vol. CX, No. 2890.

Farm Trials of Artificial Manures.

By W. A. Albrecht and E. M. Poirot.

Straw was prepared for conversion into artificial manures by the addition through the thresher at the rate of 150 lbs. per ton of straw of a starter chemical composed of ammonium sulphate 45 per cent, 10-mesh limestone 40 per cent, and superphosphate (acid phosphate) 15 per cent. When the prepared straw was placed in flat shallow piles, it was found possible under the conditions obtaining at the Missouri Experiment Station to depend on rainfall for the moisture necessary to the decomposition. It was also found possible to convert the straw of one wheat crop into artificial manure of good quality in time for use, as a winter top-dressing for the next crop. The product secured in the experiments here reported increased the yield of and improved the quality of wheat crops to which it was applied, and a photograph of sweet clover from the stubble crop in which the yield produced by lime, superphosphate and barn yard manure is shown to be markedly better than that produced by the minerals alone, shows also the sweet clover resulting from the artificial manure with superphosphate and lime, which appears as a greater proportional improvement over the results from barn yard manure than is the last named over the results from minerals alone. At the present cost of the process for nitrogen, it is

considered that the preparation and use of artificial manure would be economically successful under ordinary farming conditions.—*Experiment Station Record*, Vol. 59, No. 2.

The Indian Milk Problem.

We extract the following from a very interesting report by Mr. W. Smith, Imperial Dairy Expert :—

"The great mass of the people of India will not tolerate the killing of cattle of any age or class and India must therefore see that only efficient milkers and workers are brought into the world. The breeding results so far obtained at the Karnal farm clearly endorse the teaching of this section since its inception that the best milking cow of the proper type produces the best working male and the inferior milk-yielding cow of the same type produces the inferior working bullock, the sires being equal.....The continual and ever-increasing demand for technical advice and assistance on matters concerning the treatment and transport of fresh milk and butter, the manufacture of milk products such as casein and the casein products, condensed milk, ghee, dried milk, and the storage of dairy produce under tropical conditions, emphasizes the necessity for carefully organized research work along these lines. The Creamery at Anand is particularly suited for this class of work and the need for a scientific staff of trained chemists and bacteriologists there to carry on this work is great. The greatest fillip which this country can give to the cattle breeding industry is the organization, preferably on co-operative lines, of the ghee and milk selling industry, so that the producer of milk could obtain the real world value of his produce and thereby realize the economic value of the good milking cow as a profit earner. It is a significant fact not nearly well enough emphasized in India, that in every country in the world which has developed its dairy cattle, the organization of the marketing of milk and the manufacture of milk products preceded any improvement in the quality of its milch cattle. The cow-owner in India cannot be expected to trouble himself about getting better milk-yielding cattle, so long as he is forced to sell ghee produced by a wasteful and obsolete method at twelve annas per pound when the world value of butter fat, which after all is just pure ghee, is 250 per cent above this figure. India is crying out for accurate knowledge on all matters concerning the most vital part of her agricultural policy—the cattle problem and the Indian cattle problem is the dairy problem. India will not kill her cows once they are born and at no part of their history is their flesh required for food in India,

therefore all cows if they are to be profitable must be milch cows. This country cannot afford to feed a cow merely to act as the dam of future generations of draught cattle. Every cow must be a profitable milk yielder herself as well as the mother of the new generation of milk-givers and field bullocks. The dairy problems of India are her own peculiar problems and they will only be solved by original research, experiment and investigation in India. 'The harvest truly is plenty but the labourers are few.' "—*Scientific Reports of the Agricultural Research Institute, Pusa*, 1927-28.

Topping of Coffee.

T. B. McClelland (Bull. No. 32, Porto Rico Agric. Exper. Sta.), gives the results of some experiments to determine the effect of topping coffee trees on the yield of coffee. Tests were carried out beginning in December, 1910. The variety used was Blue Mountain of Jamaica, which is typical of the ordinary Coffea arabica. The trees were set in 24 short rows of unequal length. Rows 1 and 2 were left untopped, rows 3 and 4 were topped at 6 feet and rows 5 and 6 at 4 feet. The remaining 18 rows were treated in the same alternating sequence. The first of each of the four pairs of untopped rows received no pruning, all suckers and growth of every kind being allowed to develop freely. In the second of the untopped rows suckers were removed, so as to restrict the growth to the single original stem and developments from its laterals.

Topping forced the growth of many new uprights or suckers. These were periodically removed so as to keep the growth to the single stem and branches developing from its laterals. It was found that the picking of the crop from the topped trees was greatly facilitated, as the fruit was produced on low branches within easy reach of the pickers.

The yields of the trees were recorded over a ten-year period, 1912-21. For this period as a whole, the trees which were held to a single stem and those which were topped at 6 feet produced only 74 per cent as much as the unpruned trees whilst those topped at 4 feet produced only 58 per cent as much. The depressing effect on production exercised by severe pruning or topping was less evident in the early years of the test than later. Thus in the three-year period 1912-14, the trees which were topped at 6 feet, and those which were held to a single trunk, produced each year within 10 per cent of the yield of the unpruned trees. But in the seven following years, the same trees gave a yield equal to only two-thirds of that of the unpruned trees, whilst the trees topped at 4 feet gave only half as much as the latter.

It is, therefore, considered that whilst the topping of coffee trees considerably facilitates the collection of the crop and contributes to the uniform and well-kept appearance of the plantation, these advantages do not compensate for the heavy loss of crop entailed. It is pointed out, however, that although in the tests the wholly unpruned trees gave the highest yield, the inference that no pruning is advisable should not be made. Ordinarily suckers are produced in such numbers as to make the removal of some of them very desirable.—*Bulletin of the Imperial Institute*, Vol. XXXVII, No. 1, 1929; *Tropical Agriculture*, Vol. VI, No. 6.

Some Facts of Importance to Paddy-Growers.

By K. Venkataraman, M.A.,

Assistant Paddy Specialist, Aduturai.

There are four stages at which seed is likely to get contaminated, to wit, the seed-bed, the planted field, the threshing floor and storage receptacles.

Seed-bed.—The nursery fields often contain stray seeds fallen from the last harvested crop. Such seeds should be sprouted and removed, so that they may not get mixed up with the pure seed to be sown. For doing this, the nurseries should be ploughed and water let in for 3 or 4 days and sufficient time allowed for all the seeds lying in the field to sprout up. It is uneconomical to hand-pick and remove the sprouted seedlings. When all the seeds have sprouted which will be in about a week after the letting in of water a thorough ploughing will uproot all the sprouted seedlings, and they will gradually rot. The seed-beds should then be finally prepared and pure seed sown. This can be practised in all 'samba nurseries' in the Tanjore delta, since wet nurseries only are adopted for 'samba' crops. However, in the case of dry nurseries for 'kuruvai' crop, this precaution is not practicable and the other precautions detailed below should be taken to ensure purity.

Planted Fields.—The fields in which seedlings are to be transplanted also contain dormant paddy seeds fallen from the previous harvest. It is essential that these residual grains in the field should be sprouted and removed before the field is got ready for planting. This object is easily achieved by letting water into the field after the first ploughing and keeping the field wet for a week. The residual seeds in the field would have sprouted well by that time, and the subsequent ploughing would uproot and destroy them. The fields should then be got ready for transplanting. The flowering time of the crop is another stage at

which plants belonging to other varieties can be easily spotted out and removed. This operation is called 'roguing'. When the crop has fully flowered the very early and late plants in the field should be pulled out and removed. Other plants which look dissimilar to the general type in height, colour or habit, should also be removed. It is not necessary that this 'roguing' should be done in all the cultivated fields. It is quite sufficient to confine this operation to a small area, the harvested grain from which will provide adequate stock of seed for the next season's sowing. For example, if a ryot is cultivating 20 acres of land with a particular variety of paddy, if roguing should be done only in one field, about $\frac{1}{3}$ of an acre in extent, he will have enough pure seed for the next sowing.

Lurking Rogues.—It is a common practice for some ryots to grow different varieties of paddy in very closely adjacent fields or even in portions of the same field. Whenever two crops, 'sirumani' and 'Nellore samba' for instance, are grown in adjacent positions, a certain amount of 'natural crossing' takes place in the rows of the two crops that are in close proximity to each other. This amount of 'natural crossing' has been estimated in paddy to range from 1.4 to 2.9 per cent. If in the two varieties 'sirumani' and 'Nellore samba' grown close to each other, a spikelet of a 'sirumani' plant should get crossed with 'Nellore samba', the resultant grain could not be distinguished from other 'sirumani' grains. The crossed 'sirumani' grains would in the succeeding crop produce a 'sirumani' plant with sirumani-like grains. This is so because 'sirumani' size of grain is dominant to 'Nellore samba' size of grain. Here then is a lurking rogue, a plant so like the true type, but none the less a rogue. The lurking rogue naturally escapes observation and in the next crop produces, to the surprise of the ryot, some plants of 'Nellore samba' type and some plants of 'sirumani' type. How then is the ryot to get rid of the lurking rogues that elude the chase? The remedy is very simple, and consists of eliminating the border crop from the sheaves that are meant to be threshed for seed-paddy.

Threshing Floors.—The ordinary ryot's threshing floor is a great source of contamination. Sometimes a common threshing floor is used by several landholders, and often different varieties are threshed on the same threshing floor without any attention being paid to cleanliness. It is not certainly necessary to have costly brick or granite threshing floors, but with the exercise of sufficient care, even the ryots' ordinary threshing floor can be made to serve quite as well. In threshing sheaves, the grain from which is to be used for seed purposes, great

care should be taken to sweep the threshing floor free of all stray paddy grains, and the sheaves should be threshed right in the middle of the cleanly swept space. The grains that get scattered all round the threshing floor should not be gathered up for seed purposes. If the seed taken from such carefully threshed sheaves is kept for sowing the next season, purity of seed will be ensured. Here again, all this care and vigilance need be confined only to threshing small lots, the grain yield of which is to form the seed-stock for the next season.

Storage Receptacles.—Very commonly seed paddy is stored by ryots in straw twists (*kottais*) or in gunny bags. These straw twists are dangerous envelopes for seed paddy. However well straw may be threshed, there will still be found attached to the panicle portions of ill-filled and undeveloped grains. These half-filled and ill-developed paddy grains (commonly known as *karukkai*) sticking on to the straw have been found to germinate quite well and grow. Since threshed straw from different varieties of paddy is all usually stacked in the same heap, one can easily imagine what happens when 'sirumani' paddy seeds should be wrapped up in the 'Nellore samba' straw twists. Herein lies the danger of using straw twists for preserving seed paddy. If straw twists cannot be altogether dispensed with for storage, the obviously safest course would lie in using the straw of the same variety for each kind of paddy seeds, after making sure that straw of the wrong type has not crept in.

Gunnies, again, are receptacles that have to be used with great vigilance. When a gunny is used for storing seed paddy, it should be turned inside out and the corners and chinks examined carefully for stray grains sticking to the sides. A stray grain of another variety lurking in a corner of the gunny is enough to vitiate seed-purity if left undetected.

Lastly, seed-paddy should be dried occasionally during storage in order to keep off mouldiness, etc., and it is very necessary to exercise the strictest supervision during drying so that a few seeds of one variety do not get mixed inadvertently with seeds of another variety.

Turning to good account leaf and waste organic matter.—The application of dressings of green leaf as a fertilizer for paddy is recognized by every paddy cultivator. Green leaf is scarce in deltaic tracts and there is a keen scramble for leaf as soon as freshes in the river arrive and cultivation operations have to be begun. All available green leaf by the side of river banks, channel courses, etc., is then hurriedly gathered up and applied to nurseries and fields, but the supply proves very inadequate. If, however, during the rainy season, when hedge prunings,

weeds and other organic matter are available in large quantities, they should be turned to good account by being composted in pits together with a sprinkling of water-suspension of cattle-dung and bonemeal, a supply of synthetic farm-yard manure would have been put by for use during the ensuing season. Such pits which are used for making synthetic farm-yard manure should be protected from the sun and rain. If all organic waste matter, such as weeds, green leaves, dry leaves, etc., should be carefully utilized for making manure, the manurial problem would be rendered a little easier of solution.

Prevention of crab-damage in paddy fields, and turning dead crabs to manurial account.—Crabs cause damage to paddy crops in several ways. They nibble sprouting seedlings in the nurseries and also cut across newly planted seedlings in fields. The former mischief results in a dearth of seedlings in seed-beds, while the latter renders it necessary to fill up gaps caused by the destruction of plants. This annoyance is most felt in thin-sown nurseries and economically planted fields. The crabs also make holes through the bunds of fields and a field may get completely drained through these holes at a time when water is most needed by the crop.

A simple method of preventing crab-damage has been adopted at the Paddy Breeding Station, Aduturai, with highly successful results. The device is inexpensive and self-acting. A wide-mouthed ordinary mud-pot (*chattie*) is buried in a corner of the paddy field so that the mouth of the pot is just flush with the level of the soil in the field. The pot is baited with two handfuls of raw rice bran, moistened and made into large lumps for convenience in handling. If the whole field is under water the pot also will naturally get filled with water. This, however, will not wash out the bran in the pot as wet-bran quickly settles to its bottom. The smell of the rice bran attracts the crabs which drop into the pot and are held captive there, the sloping convex neck of the pot effectively preventing all means of escape. The bait, to wit, raw rice bran, may be renewed every alternate day. Usually five crab traps should be placed in each acre field, one near the inlet, one near the outlet, one at the centre, and two at the corners. Since channel courses act as the courses of supply, these traps may be put down in beds of channels as well. The irrigator who usually looks after the irrigation and drainage of fields may be entrusted with the looking after and baiting of these crab-traps. The crabs which fall into the pots should be cleared every day, otherwise they die by drowning after twenty-four hours, and the dead bodies start decomposing. The crabs cleared from the pots every

day should be killed and thrown into pits, and a layer of earth strewn well over to prevent birds of prey being attracted. This process is repeated every day and when the pits are full, the rotted crab manure can be dug out and applied to fields. At the Paddy Breeding Station, Aduturai, a systematic campaign against crabs resulted in the production of over 20 cartloads of manure during one season from the daily catches of crabs in crab pots. Such crab manure when tried in a field scale against an equal bulk of local cattle manure proved to be of high fertilizing value. Using a crop of Aduturai No. 1 (red sirumani) crab manure and village cattle manure were turned in at the rate of 300 lbs. per cent. and the results showed that crop reared on crab manure yielded 11 per cent more grain and 37 per cent more straw. The manurial value of dead crabs enhances the usefulness of crab traps, firstly, as a preventive measure against damage, and secondly, as a beneficial fertilizer for the crop, a case of "pressing the enemy into service".— *The Madras Agricultural Journal*, Vol. XVII, No. 2.

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HEBBAL EXPERIMENTAL FARM.

Summary of some Results obtained and the plan of Experiments now in Progress.

Lands for the Hebbal Experimental Farm were obtained in 1904 and a test crop was grown in the same year. The area then taken possession of was divided into series of ranges, each range consisting of many plots, each $\frac{1}{10}$ acre in area. These plots were gradually standardized and regular experiment was started in due course. The amount of land not having proved sufficient for all experiments, additions were made both to the dry area and the wet area. The total area of the Farm now is roughly 80 acres, 20 being wet lands and the rest dry. The scheme of experiments and the arrangements of the plots were changed in 1913, to be more in accord with the latest methods of field experiments. In the dry area are situated the buildings of all the sections working on the Farm, *viz.*, experimental section, agricultural school, engineering section, botanical section and live-stock section, each in charge of a senior officer of the Department. There are also a few quarters for the officers on the Farm, and the hostel buildings. The chief crops being experimented upon on the Farm are, Ragi, Paddy, and Sugarcane; some work is also being done on Groundnut, Castor, *Avare*, *Togari*, *Sajje* and other miscellaneous crops.

RAGI.

Ploughing Tests :—(See plot No. 12.) Right at the beginning, tests were made to compare the work of the country plough with that done by the steel plough. This was undertaken to prove practically that it pays to use the improved plough. The experiments were carried on for 3 years and the results are given below :—

	Yield of grain in lbs. per acre.	
Country plough	466	average of 3 years.
Steel plough	642	

Rainfall, June to November: 27.51 inches (average of 3 years).

Another point with regard to ploughing is the advisability of ploughing the land soon after harvest. This experiment was undertaken to prove that good yields could be obtained by timely

cultivation. Averages of results obtained for six years are given below :—

	Yield of grain in lbs. per acre.	
Ploughed shortly before sowing ..	382	average of six years.
Ploughed immediately after harvest..	758	

Rainfall, June to November : 29.62 inches (average of six years).

Recently another experiment has been started on the same lines which, it is hoped, will give us valuable information. In addition to testing one plough against another, we shall obtain comparative results of using both the country plough and the steel plough in different seasons. Sometimes it is found that the ground is too hard for ploughing after harvest. In these cases some attempt to loosen the surface of the soil by some implement, the disc harrow, seems desirable. Experience has shown that even when the the ground surface is hard, a little scratching can be done by the country plough and this is better than doing nothing at all. If this is done, the very first rain during April will enable the farmer to plough his land thoroughly.

Interculturing Tests :—After the ragi crop is thinned and weeded, the surface of the field tends to become hard and crusty after a rain. To prevent this crust formation and to keep the field free of weeds, a certain amount of interculturing has to be done. We have the ordinary *Yedekunte* (blade harrow) for this purpose. The country plough can also be used for this work. A comparative test was carried out between these two implements and the results are given below :—

	Yield of grain in lbs. per acre.
With *Yedekunte*	1,489
With country plough	1,434

While the result is somewhat in favour of *Yedekunte*, it must be remembered that once the field is worked with the country plough, further work becomes difficult, whereas with *Yedekunte*, other operations can be done more easily and, if necessary, the same operation can be done once again. Some sort of interculturing is necessary and the *Yedekunte* seems to be the implement for it.

Sowing Experiments :—Ragi is sown in so many different ways that a comparative trial was made on the Farm. The results are given below:—

Results of Autumn and Spring Ploughing. *See page 156*

Disc Harrow. *See page 150*

Sowing Ragi with a 12-tyned seed-drill. *See page 157.*

Harvest from rotation experiment plot. Ragi after *avare*; ragi after ragi; ragi after groundnut. *See page 158.*

	Yield of grain in lbs. per acre.	
Sown with drill ..	.. 1,235	average of two
Broadcasted ..	.. 1,152	years.

While drill sown ragi gave, on the average, better yields than the broadcasted plot, the results have not been conclusive about the other two methods. When the rainfall was well distributed and the soil kept moist throughout the growth of the plant, the transplanted and the *hak*, where the seed is mixed with manure and drilled in 1-foot rows, gave better yields. Where the rainfall is precarious, as it is in most parts, sowing with the drill is the best, as, in addition to giving a better crop than if broadcasted, it allows of inter-cultivation as often as necessary.

Spacing Experiments :—The common ragi seed-drill deposits the seeds in rows 5″ apart. Experiments were made with the object of ascertaining if this is the best spacing and if wider spacing would not yield better results. It was found that spacing rows 1 ft. apart gave much better yields. As this spacing would need special drills, trials were made to compare ragi sown in rows 5″ apart and 10″ apart. The results with 10″ spacing were quite on a par with those obtained with 1 ft. spacing. Such spacing can easily be given by blocking up the holes in the bowl leading to alternate tynes. This wide spacing while giving a better yield, also allows inter-cultivation which materially helps in keeping down the weeds.

	Yield of grain in lbs. per acre.	
Sown in lines 5″ apart ..	.. 957	average of 4 years.
Sown in lines 10″ apart ..	.. 1,066	

Seed Selection :—Usually there is no practice of selecting ragi for seed purposes. Experiments were therefore started with a view to see if selection of seeds would result in any increased yield and if so, what particular method of selection would be most useful. Considering that ragi seed does not have any pests, one way was to select the largest grain by running the ragi through a suitable sieve and taking only such seed as was left on the sieve for sowing purposes. The second method was to put the ragi in brine and take only those that sank in the solution, thus selecting the heaviest seed. A third method was to sieve the seed first and then select this by the salt-water method. Selection invariably resulted in good yields and considering that the process is inexpensive, every farmer ought

to adopt some method of selecting the seed. The double selection is the best and of the other, the second—the salt-water method—seems to be the better.

	Yield of grain in lbs. per acre.	
Sieved	1,130	average of two years.
Salt-water	1,315	

Rotation Experiments : (See demonstration plot 15—dry lands).

The common practice is the growing of ragi year after year on the same plot, without any rotation. That deterioration has been very slow must be attributed to the fact that ragi is rarely grown as a single crop, but almost invariably as a mixture, the other crops being *jola*, *avare*, *togari*, niger, mustard, etc., all mixed together and sown in rows about 5 feet apart. Experiments were therefore started firstly, to compare ragi grown as a pure crop with ragi grown as a mixture or *akkadi*, and secondly, to compare the yield of ragi grown continuously on the same plot with ragi grown in rotation with a legume such as *avare* and groundnut.

In the case of the first experiment, not much difference was found between the pure crop and the *akkadi* crop, but there could be noticed a slight falling off in the pure crop field. While, therefore, it is a good enough practice for small holders to grow ragi with an *akkadi* crop, for a large holder who expects to use machinery for harvesting his crop, the pure crop becomes a necessity.

The results obtained with rotation plots, have been very convincing, the continuous crop always giving a poorer return than the rotated plot as shown below :—

	Yield of grain in lbs. per acre.	
Rotation of Ragi and Groundnut..	1,449	average of four years.
Ragi after ragi	583	

For ragi rotational experiments of the new series, see plot 10.

Rotating ragi with groundnut is therefore a practice that has to be recommended strongly. Now that groundnut growing is rapidly spreading, it is to be hoped that the system of rotation will be willingly taken up by farmers. Incidentally, rotation results in a saving of manure as groundnut does not need much manure and only the ragi crop need be manured; even then a smaller quantity than usual gives quite good yields. Thus the problem of the insufficient supply of manure is solved to some extent.

Dryland Green Manuring:—In trying to solve the question of insufficient manure, experiments were started with the view of finding out if the early *mungar* rains in April could not be utilized for the growing of a suitable crop which could be ploughed in, in time for the ragi crop which is usually sown in July. Sunn-hemp and cowpea were selected as quick-growing crops suitable for this purpose. The results were quite conclusive as shown below :—

	Yield of grain in lbs. per acre.	
1. Ragi crop resulting from ploughing under a crop of sunn-hemp	..957	average of 3 years.
2. ,, cowpea	..883	
3. Cattle manure	..497	

It is thus clear that, whenever possible, all attempts should be made to utilize the April or mango showers in growing a green manure crop, preferably sunn-hemp, on ragi fields. This combined with rotating ragi with groundnut will materially reduce the manure bill of farmers. (See plot 14—dry lands.)

Experiments with fertilizers are now being conducted. (See plots 2 and 8—dry lands.)

SUGARCANE.

The very first experiments that were conducted with sugarcane were done with a view to explore the possibilities of improving the yields from sugarcane by the introduction of better varieties. These experiments showed the superiority of Red Mauritius cane, over the local striped cane, and efforts were made to supply this cane to farmers. After a time, however, it was found that the colour of the cane did not appeal to the farmers and other defects, such as the difficulty in making good jaggery out of the cane, were found. Meanwhile, as the result of work by the Botanical Section, a seedling cane—H.M. 544—was obtained, which had the yellow colour that the farmers wanted and which also gave good yields. The defects in connection with jaggery making also were not so evident in this cane. This cane, therefore, replaced the Red Mauritius and has spread over a great area in the State. The finding out of new and better varieties is a continuous process and we can never come to a finality about it. As a result of further work, another seedling cane—H.M. 320—is now being distributed on a large scale. Different places require different varieties of cane and the Botanical Section is meeting this demand from the different parts of the State with a fair amount of success.

Spacing Tests :—Early in the history of the Farm, experiments were started with a view to finding out if the spacing commonly allowed between successive rows of sugarcane was the right one or not, the usual spacing being about one foot. Cane was planted in rows, 1 foot, 2 feet and 3 feet apart, and the experiment was conducted over a series of years. These showed the decided advantage of wider spacing as can be seen from the table below :—

		Weight of canes in tons per acre.
1.	Rows one foot apart ..	.. $25\frac{1}{4}$
2.	Rows two feet apart ..	.. 27
3.	Rows three feet apart ..	.. $33\frac{3}{4}$

(See plot 2 B—wet land.)

Not satisfied that the widest possible spacing had been reached, a fresh experiment was conducted with the canes planted with 2 feet, 3 feet and 4 feet between the rows. Although in some years, the 4-feet spacing gave the best yield, the conclusion was that for the Hebbal type of soil, a 3-feet spacing was the best. This is the spacing adopted at the present time on the Farm.

The next point that was to be settled was the spacing that should be allowed between successive setts in the same row. For this purpose, four methods were taken for comparison. Firstly, planting the setts continuously end to end ; secondly, planting the setts with a gap of about nine inches or one sett length between successive setts ; thirdly, planting the setts with a gap of eighteen inches or 2 sett lengths between successive setts, and fourthly, to plant double setts instead of single setts with a double space between successive setts. It was found that planting single setts with one space is the best way. It will have to be remembered that both by increasing the distance between the furrows and by allowing a gap between the successive setts, a material saving in the total quantity of seed necessary has been effected.

		Average yield in tons per acre.	
1.	Setts Continuous ..	37.5	Average of 4 years.
2.	Single setts with one space ..	37.4	
3.	Single Setts with two space ..	35.8	
4.	Double Setts with two space ..	36.1	

Manuring Experiments:—It is commonly recognized that Sugarcane is a crop that requires heavy manuring and that it is a crop that readily responds to such treatment. Oil-cakes of various kinds being readily available, these were used. Honge-cake and castor-

cake were selected and were applied in one-ton and two-ton doses. The results are given below. The cane was local Pattapatty.

Treatment	Jaggery in maunds per acre	Value at Rs. 2-4-0 per md.	Cost of manure	Value realized from Jaggery *less* cost of manure
		Rs. A. P.	Rs. A.P.	Rs. A.P.
Cattle manure 30 cartloads ..	101.2	228 0 0	30 0 0	198 0 0
C. m. 30 cartloads and Hongey cake 80 maunds ..	184.2	415 0 0	70 0 0	345 0 0
C. m. 30 cartloads and Castor cake 80 maunds ..	195.1	439 0 0	80 0 0	359 0 0
C. m. 30 cartloads and Hongey cake 160 maunds ..	226.1	500 0 0	110 0 0	399 0 0
C. m. 30 cartloads and Castor cake 160 maunds ..	266.4	599 0 0	130 0 0	469 0 0

Bigger doses of the same were tried and these experiments were continued with two-ton and three-ton doses of Hongey and Castor cakes. The results are shown below :—

	Weight of canes in tons per acre.	Mds. of jaggery per acre.
Only cattle manure ..	19.82	190.05
Cattle manure and two tons of Hongey cake ..	35.05	350.03
Cattle manure and two tons of Castor cake ..	34.25	323.34
Cattle manure and three tons of Hongey cake ..	33.05	363.39
Cattle manure and three tons of Castor cake ..	41.04	364.95

As a result of all these experiments, it was considered safe to recommend the application of these cakes up to two tons per acre. Since the results obtained were more or less proportionate to the nitrogen content of these manures, it is now recommended that one ton of groundnut cake may be used in lieu of hongey or castor cake. During the application of the heavier doses of the cakes, it was noticed that the canes receiving the three-ton dose did not flower so early as the canes receiving the two-ton dose.

Lately, various kinds of fertilizers are being used for sugarcane. The first to be used was ammonium sulphate and this has given good results in very many places. It is now being recommended that in addition to cattle manure and other organic manure that is given to the sugarcane fields, 250 lbs. of ammonium sulphate may be given with advantage. Other fertilizers are being tried, and nothing definite can yet be said about them. (See plot 1 B—wet lands.)

Wrapping Experiments :—Wrapping sugarcane is a common practice in most cane areas in the State, except in the case of *cheni* cane which is not usually wrapped. The practice is meant to prevent the canes from lodging and it is also supposed to minimise the damage done by jackals. During the life of the cane wrapping is done about three times. This is an operation which requires a good deal of labour and may cost from 40 to 60 rupees an acre. It was therefore considered worth while to see if this practice of wrapping was really worth the money spent upon it. The results are given below :—

		Weight of cane in tons per acre.
Rows two feet apart	wrapped	46¼
	unwrapped	40½
Rows three feet apart	wrapped	52¼
	unwrapped	46¾
Rows four feet apart	wrapped	49½
	unwrapped	44¼

It will thus be seen that wrapping not only pays for itself but actually improves the yield of sugarcane. It seems therefore advisable to wrap canes whenever possible. Where for some reason it is not practicable to follow the usual procedure of giving more than one wrapping, it would be enough if the canes were wrapped once, and dead leaves etc., being picked often and the field kept clean. This will enable people to move about in the plots more easily for work, and also prevent jackals, rabbits and rats from finding a hiding place in the cane field.

Jaggery Furnace :—The use of a considerable quantity of fuel for boiling down the sugarcane juice into jaggery is a common practice. The cost of this is usually high, and complaints have been heard that in some areas, the cultivation of cane is on the wane, because of the difficulty of getting a sufficient quantity of fuel. Attempts were, therefore, made to see if a furnace could not be constructed which would eliminate the use of wood fuel entirely and

enable the cane juice to be boiled down with the help of the megasse only. A fair amount of success has attended our efforts and a furnace has been constructed which has the desired quantities. This has been fully described in the Departmental Calendar for 1926. This furnace is meant primarily for small holders who grow small areas of cane. For larger growers, bigger furnaces on the same principle could be constructed.

PADDY.

In the case of paddy also, trials are being continuously made to test different varieties of the crop. The names of varieties are so fluctuating that the difficulty of testing really representative samples has been great. As a result of previous trials, we have now on the Farm, *Alur sanna bhatta* as the standard variety for the cold season and *Chintamani sanna bhatta* for the summer season. A variety called the "Three months' paddy" which matures three months *after transplanting* is being grown on a large scale. This is not a heavy yielder. G.E.B. 24 is a new introduction and is doing fairly well.

Manurial Tests :—It is a common practice to give a certain amount of green leaf to paddy in addition to cattle manure. Tests were made with various kinds of leaf and it was proved that of all the green matter usually available, hongey leaf gave the best results. A combination of green leaf with super-phosphate was found to increase the yields considerably.

Tests were conducted to see the effect of different kinds of fertilizers on paddy and it was seen that a combination of ammonium sulphate and super-phosphate has a very good effect as shown below :—

	Yield per acre in lbs. (Average.)
1. Check (Cattle Manure)	.. 1359 lbs.—Summer crop.
Do.	.. 1870 lbs.—*Haine* crop.
2. Ammonium Sulphate alone	.. 1804 lbs.—Summer crop.
Do.	.. 2172 lbs.—*Haine* crop.
3. Ammonium Sulphate & Super	1734 lbs.—Summer crop.
Do.	.. 2135 lbs.—*Haine* crop.
4. Ammonium Sulphate *plus* Super *plus* Potash	.. 1797 lbs.—Summer crop.
Do.	.. 2312 lbs.—*Haine* crop.

(For present tests see plot 9—wet lands.)

Further manurial experiments are under way with varying

doses of fertilizers and combinations of bonemeal and superphosphate with different cakes. The effects of some of the combinations are striking.

		Yield per acre in lbs. (Average.)
1.	Check (Hongey leaf)	.. 1380 lbs.—Summer crop.
	Do.	.. 2140 lbs.—*Haine* crop.
2.	Groundnut cake and Super	.. 1770 lbs.—Summer crop.
	Do.	.. 2140 lbs.—*Haine* crop.
3.	Groundnut cake and Bonemeal	1607 lbs.—Summer crop.
	Do.	.. 2190 lbs.—*Haine* crop.
4.	Hongey cake and Super	.. 1632 lbs.—Summer crop.
	Do.	.. 2340 lbs.—*Haine* crop.
5.	Castor cake and Super	.. 1625 lbs.—Summer crop.
	Do.	.. 2320 lbs.—*Haine* crop.
6.	Castor cake and Bonemeal	.. 1685 lbs.—Summer crop.
	Do.	.. 2480 lbs.—*Haine* crop.

Age of Seedling Experiments :—No definite information being available about the stage at which seedlings could be removed from the nursery and transplanted, experiments were started with seedlings 25 days, 35 days and 45 days old to see which would do best. We invariably found that 25 days old seedlings gave a better yield. This is now the standard practice on the Farm.

Seed-Rate in the Nursery :—The usual practice in the preparation of seedlings is to sow about 80 *seers* of paddy in one-tenth acre of nursery and to use the seedlings so obtained. Tests were taken on hand to see if a smaller seed-rate would not answer and beginning with 12 *seers*, we have used, 20, 30 and 40 *seers* to one-tenth acre of nursery. The results have been rather conflicting, the 40 *seers* having given best results for some years, and the 30 and 20, for a few years each. The experiments are being continued. (See plot 6—wet lands.)

In addition to the three crops mentioned above, trials have been made with varieties of groundnuts, castors, *togari*, etc. The tests with groundnut varieties have proved the superiority of Mauritius and Sogatur groundnuts among the trailing varieties. The new varieties of groundnuts produced by the Botanical Section are now being tried along with the old ones.

The area north of the Dairy has been levelled and made ready for the starting of an orchard and a botanical garden for the use

of the students. A few Bonsda cocoanuts have been planted to see how they will do in the locality.

DRY AREA EXPERIMENTS.

PLOT NO.

1. Students' plots—Ragi (*Eleusine coracana*) and Horse-gram.
2. Ragi Fertilizer experiments (Am_2SO_4, Nitrolim and Oil-cake).
3. Castor and Avare (*Dolichos lablab*).
4. Ragi varieties.
5. Groundnut varieties.
6. Ragi varieties.
7. Students' study plots.
8. Ragi fertilizer experiments.
9. Ragi (Bulk).
10. Ragi rotational experiments (Ragi, Groundnut and *Togari*).
11. Ragi (Bulk).
12. Ploughing experiments.
13. *Togari* (*Cajanus indicus*) and cowpeas (*Vigna catiang*).
14. Dry land green manure demonstration.
15. Rotation demonstration (Ragi and Groundnuts).
16. Irrigation experiments (to be started).
17. Dairy fodder area.
18. Ragi varieties (Botanical Section).
19. Groundnut varieties (Botanical Section).

20.–25. Miscellaneous (New plots).

WET AREA EXPERIMENTS.

PLOT 1 A.—Rotation plot.
,, 1 B.—Sugarcane fertilizer experiments (H.M. 544).
,, 2 A.—Rotation plot.
,, 2 B.—Sugarcane spacing tests.
,, 3 A.—Sugarcane varieties.
, 3 B.—Rotation plot.

Plot	4	A.—Sugarcane varieties.
,,	4	B.—Rotation plot.
,,	5	A.—Sugarcane varieties (Botanical Section).
,,	5	B.—Rotation plot.
,,	6	Paddy seed rate in the nursery plot.
,,	7	Paddy—Spacing tests.
,,	8	Paddy—Duty of water experiments.
,,	9	Paddy—Fertilizer tests.
,,	10	Paddy—(Botanical Section).
,,	11	Paddy—Nursery plots.
,,	12 and 13	—Extra plots.
,,	14 and 15	—Paddy fertilizer tests.
,,	16 and 17	—Paddy varieties tests.
,,	18	—Outskirts.

PLANT SELECTION AND BREEDING OPERATIONS.

Plant selection work was started on the Hebbal Farm in the year 1913. During that year it was discovered that ragi was a self-fertilized plant and based on this information extensive selection work was started in that year. The result of that year's selection work has been the isolation of H 22, H 2, H 40 and some other heavy-yielding strains of ragies. The object was to evolve strains of different varieties of crops to yield more than the present local ones and to withstand drought, pests and diseases.

Of the local varieties, Bangalore Hullubele was found to be the best but the pedigree seeds yield from 10% to 30% more than the Hullubele. For yields see Table 1.

In 1914, work on sugarcane improvement was started. Large number of seedlings from seeds have been raised. From various selections made since then the following seedling canes have been evolved :—*viz.*, *H.M. 544, H.M. 320, H.M. 353 and H.M. 602. Though local Pattapatty is a rich cane, it has not got the vigour to produce heavy yields like those obtained in Java or Hawaii. Plants raised from seeds set in flowers generally vary in vigour, sugar, habit and colour.

Erect varieties of groundnuts ripen earlier than the spreading ones and have a higher per cent of oil, but the yields are only between

* H.M.=Hebbal-Mysore.

35% to 45% of the vigorous spreading ones. It has been attempted to obtain new plants having erect habit, earliness, vigorous growth and high per cent of oil. To attain this object many hybridizations of varieties were undertaken. As a result of this work many erect varieties of groundnuts with desirable commercial characters and high-yielding capacity have been evolved. Two such ones are H.G. No. 1 and H.G. No. 2.

Work on the selection and study of castors is in progress. A beginning in selection work on *Avare* and Horse-gram has been started.

Work on paddy was taken on hand in 1920 and now it has been wholly transferred to the Nagenhalli Farm where all problems connected with paddy are being solved.

Amongst the garden crops, ragi and potatoes have been studied. Some good selections of ragies have been made. K1, K2, H 41 and H 42 are much in demand. New plants from seeds of potatoes were first raised in 1922 and several promising selections have been made and it is hoped that heavy yielding, disease-resisting varieties will be available within a couple of years. Work on indigenous and exotic grasses has been very encouraging. G.E.B. 24, a good fine paddy received from Coimbatore, has been multiplied and distributed in large quantities from Nagenhalli Paddy Breeding Station.

THINGS TO SEE ON THE FARM BREEDING PLOTS.

Ragi :—

1. Standard varietal plots in II B—Plot 3 (Dry lands). There are 14 main varieties here.

2. Pedigree seed plots 5 and 7 in II B. (Dry lands).

3. Ragi selections and varietal plots in all the fields of II A. Dry lands.

4. H 22 and H 2 plots behind the Veterinary Hospital. These plots were sown last but heavily manured with Ammonium Sulphate, Potassium Sulphate and Super-phosphate.

5. Ragi-sowings in various seasons in the garden area.

Groundnuts :—

All plots have been limed and manured with artificials.

1. Varietal plots in II B.—Plot 4.

2. H.G. Groundnuts in II B.—Plots 6 and 8.

3. Selections from various hybrids in Plots 10, 12 and 14 in II—B Section.

4. H.G. No. 2 Groundnuts in II—B Section.

5. Unlimed and unmanured plot of H.G. No.1 in the plot west of Veterinary Hospital.

Castors and Avares :—

1. Selections
2. Varieties

} Sown in April. II—B Section.

Sugarcanes :—

1. Varieties of all kinds, both indigenous and exotic, in S range of wet lands.

2. Selected seedling canes about forty in B range wet lands.

3. Promising seedling canes. H.M. 320, 553, 544, 602 and others at the far end of the wet lands.

Grasses :—

These are in the garden enclosure. Note the new grass *P. purpureum.*

TABLE I.

Yields of standard ragies in % comparison.

A fair yield of Hullubele may be taken as 1000 lbs. or 5 *pallas* per acre.

1.	Hullubele ..	100	
2.	Junumudda ..	89.4	per cent.
3.	Hasarukambi ..	87.5	,,
4.	Madayyanagiri I ..	86.8	,,
5.	Madayyanagiri II ..	82.3	,,
6.	Dodda Ragi ..	81.4	,,
7.	Kare Gidda ..	77.0	,,
8.	Gidda Ragi ..	76.3	,,
9.	Jadesangha ..	71.3	,,
10.	Majjige ..	52.2	,,
11.	Rudrajade ..	47.7	,,

TABLE II.

Pedigree seeds of Ragi :—

The yields are given in percentages. Local Hullubele yield is taken as 100 % which is equivalent to 1000 lbs. per acre or about 5 *pallas* of grains.

H. 2	119.0	%
H. 40	117.5	%
H. 32	115.6	%
H. 19	114.6	%
H. 39	113.0	%

H. 72	..	112.9 %
H. 3	..	112.7 %
H. 46	..	111.7 %
H. 59	..	109.7 %
H. 73	..	109.5 %
H. 13	..	109.1 %
H. 22	..	103.0 %
Hullubele	..	100. %

TABLE III.

SUGARCANES.

Some good exotic canes and seedling canes have done well on the Hebbal Farm. The yields are those of Jaggery in maunds but given in percentage comparisons. Local Pattapatty may be taken to yield about 250 maunds of Jaggery per acre under a fairly good cultivation.

	Yields of Jaggery in maunds per acre.
H.M. 320 ..	125.7 %
H.M. 544 ..	116.3 %
H.M. 313 ..	107.9 %
H.M. 312 ..	105.0 %
Red Mauritius ..	100.0 %
P. O. J. 33. (a) ..	91.1 %
Cheni ..	70.1 %
Local Pattapatty ..	70.6 %
Rasthali ..	69.2 %
Java 247 ..	67.4 %
Java—Mysore ..	65.0 %

TABLE IV.

Groundnut yields are given in percentage yield comparisons. A good yield of Sogatoor per acre is about 1600 lbs. dry pods per acre or sixteen *pallas*.

Spreading varieties :—	*Dry pods per acre.*
1. Sogatoor ..	.. 100 %
2. Carolina ..	.. 93.7 %
3. Barbados ..	.. 90.3 %
4. Transvaal ..	.. 86.1 %
5. Virginia ..	.. 83.9 %
6. Pondicherry ..	.. 75.3 %
7. Brazil ..	.. 73.3 %
8. Mysore ..	.. 48.0 %

Erect varieties :—

9.	H. G. No .1	..	80.0 %
10.	Spanish	..	49.9 %
11.	Small Japan	..	36.8 %

TABLE V.

Close planting of groundnuts has always shown higher yields in all varieties both in spreading and erect varieties.

Six Year Averages :—

Varieties	Yield per acre in lbs.		% Comparisons		Difference between 12" and 6" per cent
	12"	6"	12"	6"	
Spreading—					
Sogatoor ..	1922.8	2263.5	100.0	122.5	22.5
Carolina ..	1714.1	2205.6	88.5	114.3	25.8
Barbados ..	1659.8	2211.8	85.0	108.9	23.9
Transvaal ..	1659.5	2100.1	85.2	111.9	26.9
Mauritius ..	1647.3	2020.8	83.6	104.6	21.0
Virginia— ..	1456.0	2156.3	75.4	111.5	36.1
Brazil ..	1417.5	1852.6	75.1	96.9	21.8
Pondicherry ..	1411.5	1940.6	74.6	101.0	26.4
Big Japan ..	1406.5	1771.0	74.4	92.7	18.3
Average for spreading varieties ..	1588.6	2048.8	82.4	107.1	24.7
Erect—					
Small Japan ..	642.6	995.6	32.4	59.2	21.8
Spanish ..	926.8	1433.6	57.5	81.2	23.7
Average for erect varieties ..	784.7	1214.3	44.9	67.7	22.8
Total average..	1442.4	1897.0	75.6	99.9	24.3

THE HEBBAL DAIRY.

The Dairy Section was added to the Farm in the year 1915 with the main object of imparting instruction in dairying to the students of the Agricultural School, Hebbal. The foundation herd consisted of several breeds headed by a *Hallikar* bull. By discarding a number of animals a uniform type has now been obtained which conforms to that of the *Hallikar* breed. The policy has been to effect improvement in the milk yield of *Hallikar* breed by

careful selection, better feeding and management and grading. The results achieved so far are not encouraging chiefly because of want of right kind of sires.

The performance of a few best foundation cows and their off-springs are given hereunder :—

Names of Cows	Average No. of days in Milk	Average daily yield during lactation	Average No. of days dry	Average over
		lbs.		
1. *Laxmi.*	233	7.7	173	6 Lactations
Progeny No. 1	186	7.3	163	do.
2. *Ranee.*	279	8.5	185	7 do.
Progeny No. 1.	252	6.9	113	5 do.
„ No. 2.	217	6.3	122	3 do.
„ No 3.	217	7.7	216	4 do.
„ No. 4.	200	5.7	205	3 do.
3. *Leela.*	325	6.7	46	6 do.
Progeny No. 1.	282	5.4	75	3 do.
„ No. 2.	213	5.0	64	3 do.
		one seer=three pounds.		

Heifers on the Farm mature earlier than those kept in villages and breed regularly. Hand feeding of calves from birth is being successfully carried out for the past 8 years.

Ensilage is the only kind of roughage fed to the dairy stock. This method of storing green fodder against hot weather at least, seems to have much to commend it and is worthy of much more attention on the part of stock-owners than it receives at present. The need for such extensive areas of "*Gomala*" would be lessened and the quality of cattle would be much improved if this plan were to receive general adoption.

Average capacity of soils and average percentage of wastage :—

		Average capacity	Average percentage of loss
Cylindrical Silos.	20′×10′	27 tons	11
„ „	25′×10′	32 „	10
„ „	30′×12′	38 „	10
Trench Silos.	60′×6′×6′	40 „	14

Materials used :—*Jola*, Cowpea, Maize and Sunflower, chaffed about 1" long.

Cream separating and butter making appliances used on the Farm are all of the kind suitable for small dairies and village co-operative dairying concerns.

SHEEP FARM.

Work on the improvement of sheep was taken up on the Farm from the year 1920. Production of half-breds has been the main line of work until this year. Owing to heavy mortality among merinos and half-breds due chiefly to stomach worms and limited area under pasture, the strength of the flock is considerably reduced from this year and intercrossing of quarter-breds alone is taken up. The flock is maintained chiefly for instructional purposes.

The following is the average yield of wool of different breeds :—

	Ram. lbs. oz.	Ewe. lbs. oz.	Market value. per lb.
Merino	6 14	3 10	
Half-bred.. ..	2 0	1 7	Rs. 1-2-0
Quarter-bred	2 4	1 3	
Country	1 8	0 12	Rs. 0-8-0
„ (black or mixed.) ..			Rs. 0-4-0

Systematic dosing of sheep with Cooper's worm tablets has very considerably reduced the mortality. A cheaper kind of anthelmentic is being tried from this year.

During summer for want of sufficient grazing the sheep are fed with ensilage. Ewes with lambs, rams and young stock get concentrates (wheat bran and groundnut oil-cake in the proportion of 4 to 1, by weight). They get also a lick consisting of common salt, ferrous sulphate and copper sulphate in the proportion of 20-1-1, by weight. Sheep are shorn once a year in January and not twice as is the usual practice out in the districts and are given two dippings during the year to keep off lice.

THE MYSORE AGRICULTURAL AND EXPERIMENTAL UNION.

Programme of Experimental Work for 1930.

CIRCULAR.

The Department of Agriculture desires to arrange with members of the Mysore Agricultural and Experimental Union for the carrying out of the experiments mentioned below. Members intending to undertake experimental work are requested to apply to the Secretary, The Mysore Agricultural and Experimental Union, Seshadri Road, Bangalore, before the end of December 1929 marking out the experiment or experiments they desire to undertake on this Circular itself. The seed, manure, etc., will be supplied in the order in which the application is received as long as the stock lasts.

1.—Experiments with seeds.

Trial of selected strains of—

(*a*) Ragi—seed enough for 3 guntas each of two new varieties will be supplied.

(*b*) Groundnut—seed enough for 3 guntas each of one or two new varieties will be supplied.

(*c*) Cotton :

(1) Doddahatti—seed enough for 3 guntas will be supplied.

(2) Sannahatti—seed enough for 12 guntas each of two varieties will be supplied. (Trials confined to cotton areas only.)

(*d*) Paddy—seed enough for 3 guntas each of two varieties will be supplied.

(*e*) Sugarcane—seed enough for one gunta each of two Hebbal seedling canes will be supplied. Arrangements for the conveyance of seed setts from the nearest railway station should be made by the member indenting for them. Applications for sugarcane setts should be made so as to reach the Secretary before the end of December stating the probable time the setts should be supplied.

Conditions of Supply of Seed.

1. The seed of each variety shall be sown in separate plots with check plots arranged as per instructions sent with the seed.
2. The results of experiments shall be reported after harvest in the form which will be supplied.
3. The experiments shall be conducted continuously for at least three years, seeds for the second and subsequent sowings being reserved from the first supply by the Agricultural Department.

2.—Experiments with Manures.

I. Sugarcane—Comparative trial of 80 lbs. of ammonium sulphate and 3 cwts. of superphosphate per acre applied before planting and 160 lbs. of sulphate applied again about 10 weeks after planting, against—

1. Only 3 cwts. of super at planting and 240 lbs. of sulphate about 10 weeks after planting, *or*

2. 100 lbs. of Ammophos 13–48 grade at planting and 160 lbs. of sulphate of ammonia 10 weeks after planting, *or*
3. 100 lbs. Diammonphos 20–53 grade at planting and 160 lbs. of sulphate of ammonia 10 weeks later on.

Not less than 10 guntas of land will be required.

II. Paddy—Trial of 250 lbs. of groundnut cake and 1½ cwts. of super per acre against—

(*a*) 120 lbs. Ammophos 20–20 grade, *or*
(*b*) 100 lbs. Leunaphos, *or*
(*c*) 100 lbs. Diammonphos 20–53 grade.

Not less than 10 guntas of land will be required.

3.—Areca.

Trial of a mixture of 400 lbs. groundnut cake, 100 lbs. concentrated super and 120 lbs. muriate of potash per acre of 400 bearing trees against—

(*a*) 160 lbs. sulphate of ammonia, 100 lbs. concentrated super and 120 lbs. muriate of potash, *or*
(*b*) 200 lbs. Ammophos 20–20 grade and 120 lbs. muriate of potash, *or*
(*c*) 150 lbs. Diammonphos and 120 lbs. muriate of potash.

A minimum of 180 bearing plants are required for the purpose.

All manures except oil-cake and muriate of potash will be given free. These two will have to be purchased by the member.

4.—Experiments on the Control of Insect Pests.

(*a*) Sugarcane Borer.
(*b*) Pests of Stored Pulses.
(*c*) Coffee Borer.
(*d*) Cardamom Caterpillar.
(*e*) Lime-tree Borer.
(*f*) Avare Pod Borer.

} Printed instructions will be sent on requisition.

5.—Experiments on the Control of Fungus Diseases.

(*a*) Black Rot of Coffee.
(*b*) Treatment against Smut on Jola.
(*c*) Spraying against *alternaria* disease of potato.

6.—Experiments on Fodder Conservation.

Use of sunflower, jola and other fodder crops for ensilage. Printed instructions will be sent on requisition.

BANGALORE, 24—11—1929.

LESLIE C. COLEMAN,
President,
The Mysore Agricultural and Experimental Union.

DEAR SIR,

I desire to undertake the experiments ticked off on the Circular during the coming season. I agree to conduct the experiments and report results as required. Please arrange to supply the requirements.

Station.....
Date.....

Yours faithfully,

Signature and Address of the Member.

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